MEMORANDUM

To: Amy Hambrick, U.S. EPA, Sector Policies and Programs Division/Natural Resources and Commerce Group

From: Eastern Research Group, Inc.

Date: January 2011

Subject: Post-Proposal SSI Database Revisions and Data Gap Filling Methodology

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1.0 INTRODUCTION

This memorandum summarizes the data revisions made to the Sewage Sludge Incinerators (SSI) unit inventory and emissions database after the rule's proposal. Details about the database and its initial development can be found in the Inventory Database memorandum[1] and the emissions database memorandum.[2] The data discussed in this memorandum reflects the data used in preparation of the final standards. Section 2.0 describes the changes made to the basic inventory data based on comments received after proposal. Section 3.0 describes the revised data gap filling methodology used for parameters such as unit capacities, feed rates, flow rates, and hours of operation. Section 4.0 describes additional adjustments made to the extrapolated data on a unit-specific basis.

2.0 INVENTORY REVISIONS

Comments containing facility- or unit-specific data were reviewed and compared to the original inventory data. Where applicable, new data or data corrections were incorporated. Table 2-1 documents the changes made to the inventory data, as well as any additional supplemental data that could be used in subsequent cost or emissions analyses.

The inventory revisions resulted in the removal of 19 multiple hearth (MH) units and 1 fluidized bed (FB) unit from the inventory, as well as the addition of 6 new fluidized bed units. The new inventory contains 144 MH units and 60 FB units.

The dry sludge capacities for 13 units were added or revised based on comments. In many cases, commenters provided the number of dry tons or wet tons incinerated per year. If operational hours were also provided, these values were used to estimate an average feed rate in dry tons per hour. Similarly, if an average feed rate and the annual tonnage incinerated were provided, these values were used to estimate operational hours. Other similar calculations were made as appropriate, to fill in as many gaps as possible, based on the comment data. Operational hours were updated for more than 50 units, average feed rates were updated for 38 units, and average flow rates were updated for 24 units. Additionally, service area populations were updated for about 40 units.

Baseline emissions and/or concentrations for several units were provided in the comments. These data could not be used to revise the emissions database because background documentation (test reports) were not provided to verify the information or to convert the results into units used in the analyses.

Table 2-2 presents a clean version of all of the 'known' data based on the original inventory, ICR responses, and data received during the comment period. Red text indicates revisions made based on data received during the comment period. The data in this table was used, as described in the next section, to fill data gaps for all units with limited or no data.

3.0 FILLING DATA GAPS BASED ON REVISED DATA

Parameter values for units with no data were extrapolated based on the data shown in Table 2-2. The final values are presented in Table 3-1. The methodology used for each parameter is described below.

A. Sludge Capacity (dry tons per hour)

Known dry sludge capacities were summed by owning entity, and these total capacities were plotted against the owner's service area population. The linear regression yielded an R^2 value of 0.66, and it was considered sufficient to use this linear relationship to extrapolate unknown capacity values based on an owner's population. Calculated capacities per owner, and subsequently per unit, are presented in Table 3-2.

B. Hours of Operation

The annual hours of operation for some facilities were provided during the comment period. However, for facilities with multiple units, commenters did not always provide information on whether or not all units operate at the same time. This information is important in determining an average number of hours per year *each* individual unit operates. For instance, PAAlleghenyCounty reported in their ICR survey that they incinerate 8,760 hr/year (or full time). However, they also specify that only one unit operates at a time. Therefore, each of the facility's units is assigned an average of 4,380 hours per year. This methodology was applied to all multi-unit facilities for which it was specified that not all units operate simultaneously. For multi-unit facilities for which it was specified that all units operate at the same time, the total facility operating hours were applied to each unit, rather than divided among the units. For 2-unit facilities for which this information was not specified, it was assumed that only one unit operates at a time, as this appears to be the more common practice. Table 3-3 lists the hours reported for each facility or unit, interpreted as described above.

These 'known' hours were then averaged based on the number of units per facility. As previously noted, 2-unit facilities were treated as two groups: those for which both units run simultaneously, and those for which only one operates at a time. Averages

are presented in Table 3-3. These averages were applied to fill the gaps for units with unknown operating hours.

C. Annual Sludge Incinerated (dry tons per year)

Data gaps for the amount of dry tons per year (dtpy) incinerated at a given unit were filled as follows:

1. Calculations based on other 'known' parameters:

    - If wet tons per year were provided, this value was multiplied by 0.28 (an average moisture content for dry sludge) to convert to dtpy.
    - As described in Section 2, if 'known' values for both average feed rate and operational hours were available, these were multiplied to get dtpy.

    These calculated values are presented in the 'Calculated dry tons/yr (based on known info) column of Table 3-4A.

2. These 'known' values were summed by unit owner and plotted against the owner service area population. This was done separately for 1-unit entities and 2-unit entities, as shown in Table 3-4B. The equation for the resulting linear regression was then used to extrapolate data, based on population and number of units per entity. For entities owning more than 2 units, the ratio of dtpy to owner service area population for known data was determined and multiplied by the populations of entities with no data. Specific calculations are included in Table 3-4C. In some cases for entities owning multiple units, the units don't have identical capacities or operational hours. To account for these differences in these cases, annual dry tons per year were adjusted based on the fraction of total entity annual operating hours contributed by each unit.

D. Average Feed Rate (dry tons per hour)

Once all gaps were filled for annual operating hours and annual dry tons incinerated, these values were used to fill in the remaining gaps for the average dry tons per hour. These calculations can be found in Table 3-5.

E. Average Flow Rate (dry standard cubic feet per minute)

Several different types of flow rates were required for different types of analyses. For cost analyses, flow rates needed to represent a 'potential' flow rate based on sludge capacity in order to estimate control costs. These maximum flow rates were represented by the set of flow rates extrapolated based on unit design capacities, as described below. For emission reductions and other analyses, another set of flow rates that would represent values based on 'actual' sludge usage was needed. These 'average' flow rates were extrapolated based on average feed rates. Additionally, for emissions analyses, flow rates needed to be converted to 7% oxygen.

Known flow rates, based on ICR survey responses, submitted test data, and additional data provided during the comment period, were plotted against known dry sludge capacities. The resulting linear regression was used to extrapolate flow rate values, using the known and extrapolated capacity data, for the remaining units with no flow rate data. These flow rates were used in costing algorithms. Calculations are shown in Table 3-5, in the 'Final Flow Rate (dscfm) Based on Capacity' column. The same equation was then applied to the actual and extrapolated feed rates in order to determine flow rates based on actual sludge usage. Calculations can be found in the 'Final Flow Rate (dscfm) Based on Avg. Feed Rate' column in Table 3-6.

Before applying these two sets of flow rates to emissions calculations, they needed to be converted to 7% oxygen, in order to be compatible with emissions concentration data. For units having emissions data, flow rates were converted directly based on reported O_2 values. For units without emissions data, average O_2 values were calculated for each subcategory, based on emissions test data, and those averages were applied to each set of final flow rates. The average O_2 value for FB units was 10.1 percent and the average for MH units was 10.5 percent. These calculations are shown in the last two columns of Table 3-6. For the emissions analyses, the 7% O_2-converted flow rates based on capacity were used to determine 'potential' emissions, and those based on average feed rates were used to determine 'actual' emissions. Further details on how these emissions were calculated can be found in the baseline emissions memo[3] and the cost and emission reduction memo.[4]

4.0 FINAL ADJUSTMENTS TO EXTRAPOLATED DATA

Because operational hours per year, dry tons per year, and dry tons per hour are all related, and because by definition the unit capacity must be greater than or equal to the sludge feed rate, several discrepancies became apparent when all extrapolated data were compared. Where appropriate, on a unit-specific basis, extrapolated data were revised to resolve these discrepancies. For instance, as an artifact of the methodologies used to fill data gaps, the City of New Orleans (East Bank) was assigned a design capacity of 2.94 dtph, but an average feed rate of 3.02 dtph. The unit capacity was therefore revised to be 3.02. In cases where this happened but the unit capacity was a 'known' value (rather than extrapolated), extrapolated values for the other parameters were adjusted to bring the average feed rate down to the capacity value. In many cases, an average utilization factor (see Utilization Factor column in Table 2-2) could be applied to revise the feed rate.

Table 4-1 presents the refinements that were made. Table 4-1A highlights in red the units for which refinements are needed based on the initial extrapolated data. Table 4-1B documents final parameter adjustments and, where appropriate, includes comments to describe what was done. These changes were incorporated in the flow rate calculations as well as in the final gaps filled table (Table 3-1).

5.0 REFERENCES

1. "Development of the Inventory Database for the Sewage Sludge Incinerator Source Category" Memorandum from Eastern Research Group, Inc. to Amy Hambrick, U.S. Environmental Protection Agency. June, 2010.

2. "Facility, Unit, and Emissions Test Database for the Sewage Sludge Incineration Source Category" Memorandum from Eastern Research Group, Inc. to Amy Hambrick, U.S. Environmental Protection Agency. June, 2010.

3. "Revised Estimation of Baseline Emissions From Existing Sewage Sludge Incineration Units" Memorandum from Eastern Research Group, Inc. to Amy Hambrick, U.S. Environmental Protection Agency. January, 2011.

4. "Revised Cost and Emissions Reduction of Complying with the MACT Floor for Existing SSI Units" Memorandum from Eastern Research Group, Inc. to Amy Hambrick, U.S. Environmental Protection Agency. January 2011.